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By- Jenkinson, Marion D.

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The lack of existing research on the cognitive processes in reading is discussed. The definition of cognitive processes, appropriate measuring instruments, concensus concerning the activity to be measured, and problems inherent in the materials and the reader are cited as limitations that are responsible for a shortage of research. Implications for classroom practice based on what research has been done are noted as follows: (1) aptitudes, attitudes, and abilities which will mature into basic cognitive abilities must be developed, (2) a systematic, sequential development process must be used, (3) judgment must be cultivated, (4) the ability to recognize relevant and irrelevant statements must be refined, (5) different thinking modes must be developed, (6) teacher means of eliciting comprehension must be expanded to include depth questions, outlining, summarizing, precis writing, and student-formulated questions, and (7) constant attention must be given to the development of each skill. Further research is recommended. References are listed. (BS)

Marion D. Jenkinson,
Chairman, Department of Curriculum,
The Ontario Institute for Studies in Education,
The University of Toronto,
Toronto, Ontario, Canada.

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COGNITIVE PROCESSES IN READING: IMPLICATIONS FOR FURTHER RESEARCH AND CLASSROOM PRACTICE

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Though reading is noted as the area of the curriculum which has been subjected to the greatest amount of research, it is surprising that there is such a paucity of material which deals with the problems of higher literacy as described by Chase, (3) or technological literacy as described by Jenkinson. (9) It is frequently assumed that if the words are decoded, meaning will be automatically understood. Though word recognition is a prerequisite of reading, it does not guarantee understanding. There is a good deal of verbal recognition in textbooks on reading that attention needs to be paid to comprehension at later levels because of the increasing

complexity of the concepts contained in the material, because of the more involved language structure used, and finally because the material calls forth more mature cognitive processes on the part of the reader.

One of the reasons for this small amount of research probably lies in the nature of the complexity of this activity and secondly, because historically this has not been seen as imperative until comparatively recently. Moreover, as an area ripe for investigation, it is plagued by the problems attendant on research at the frontier of any field.

There is lack of definition about the subject being investigated. Many investigators have linked reading cognitive processes as synonymous with critical thinking. Yet thinking in reading is a specitic controlled activity, the control being dependent on the thoughts engendered by the materials read. But even critical reading has been so variously defined that it is frequently impossible to relate the disparate findings and conclusions of different studies.

In addition, there are particular difficulties specific to the investigation of this needed area of knowledge, such as the lack of appropriate measuring instruments or even consensus concerning the activity which is to be measured. Furthermore, there are a myriad of topics which are conceived as contributing to the thinking processes involved when the thinking is that type of mental activity triggered by the printed word. Although there has been some experimentation in appropriate teaching methods, this lack of clarity of definitions basic to the area, has resulted in lack of cohesion with respect to the endeavours aimed at developing

appropriate teaching and learning techniques of reading comprehension.

PROBLEMS OF DEFINITION

The problems in differentiating the varied conceptions of terminology has recently been the subject of some attention. (4) (16) (20). It is clear that some of the theoretical models of reading and many of the experimental analyses of the reading act cover at least three dimensions of the concepts of reading. On the one hand, there is the attempt to define the problem in terms of the perceptual and cognitive processes involved in reading and to delineate the distinctive nature of the reading act. Secondly, there is the plethora of analyses of the skills and abilities involved in reading, both in terms of word knowledge and of the comprehension of longer passages. Thirdly, there are the appropriate techniques which appear pertinent to reading instruction.

Many experts have given summaries of the cognitive processes which they felt were involved in the reading process. One of the best known is that by Gates:

> - - - However, to say that reading is a thought getting process is to give it too restricted a description. It should be developed as a complex organization of patterns of higher mental processes. It can and should embrace all types of thinking, evaluating, imagining, reasoning, and problem solving. Indeed it is believed that reading is one of the best media for cultivating many techniques of thinking and evaluating. (3)

While this is an adequate summary, some parts of it should be further commented on in the light of thinking which has occurred since Gates wrote in the N.S.S.E. 48th Year Book.

Some researchers tend to concentrate on reading as a type of problem solving. They suggest that the reader defines the problems when he assesses the author's purpose for writing and determines his own purpose in reading and proceeds through the traditional problem solving steps. (19)

Other writers have seen reading in terms of a confluence of converging and divergent thinking. (11) The convergent occurs because the reader must lay his mind open to the precise meaning that the author is presenting but his thinking may become divergent when he reacts to and then assimilates the ideas from the material.

Another way of examining reading is to look at it in terms of a systems approach and see reading as featuring both an open and closed system. (10) This requires extrapolation, interpolation, and re-interpretation in the light of the reader's reaction.

Considerable stress has been placed by others on the cognitive problems involved in both inferring and deriving meaning through both interpretation and extrapolation and Barrett has presented a taxonomy of reading comprehension which details eight different types of inference. (2) This taxonomy also emphasizes the problems of reasoning in reading and suggests that the reader must be aware of the logical and psychological problems involved in the ideas presented. This logical analysis will be dependent upon the reader's ability to analyse and synthesize and frequently reorganize the ideas and information that is presented. This may be done by means of classifying, outlining, summarizing, and consolidating through synthesis both the explicit and implicit ideas presented. This ideally leads the reader to

make the appropriate judgments but such judgments go beyond literal comprehension and involve interpretation and evaluation.

Though most of the research has tended to stress the cognitive aspect of the process, some attention has been directed to the affective domain which must be part of appreciation. Studies which have revealed this have usually been concerned with the factors that are involved in reading literature.

A major problem arises, too, because most of the definitions of cognitive processes involved in reading are rarely made explicit by the researcher. The reader of the research is left to infer this either by the questions the research attempts to answer or by the research activity mode, or by the measures used. It would appear that too few researchers work from an explicit concept and state specifically what is precisely the problem under investigation. The confusion and lack of consensus concerning definitions of cognitive reading processes is reflected inevitably in diversity of approaches in the research. Some have stressed the importance of developing logical awareness and logical elements sequentially and at appropriate levels. Others have focussed on developing critical judgments in terms of the examination of evidence, of suspending judgment, of the reader asking appropriate questions of the material presented, or making readers assess the validity of the ideas presented. While much of this involves so called critical judgment, the elements of classical rhetoric have also been included, particularly at the high school and college level.

Perhaps the greatest confusion arises from the plethora of attributes

that are included in the higher levels of comprehension and particularly those in which critical reading is involved. The recent summary by Huus (8) gives some idea of the great divergence amongst researchers even of definitions of critical reading.

It would thus appear to be imperative that a synthesis is made of these concepts in order that the commonplaces may emerge. In addition, it seems essential that any future researcher should make explicit his concept and his dimension of the particular sphere of both reading and reading processes which he is investigating. Too frequently, the implicit assumptions are contradictory to the conclusions. Moreover, it would appear that future researchers should also differentiate clearly their investigations into process as opposed to those research activities which are primarily designed to increase our knowledge of appropriate learning and teaching activities.

The most glaring omission, however, in this whole examination of the cognitive process and its relation to reading is the scant attention which is paid at the level of theoretical rather than pragmatic analysis. Moreover, the problems of developing cognitive capabilities which evolve as the child progresses through school are rarely considered. Some recognition of this has been made by Wolf et alia (21) in their studies which aimed at developing logic sequentially through grades I to VI. But this is an isolated example. It would seem that we should investigate closely the classifying, categorizing capabities of the child which Piaget, Vygotsky and Luria have shown as developing slowly throughout the school years. The ways in which a child matures from concrete operations to the ability to

manipulate abstractions has seldom been recognized by researchers in this field.

An additional problem arises since a child may be capable of increasingly mature cognitive operations in his everyday expressional activities, but there is some evidence (14) that there is a lag between the acquisition of concepts in conservation, classification, probability etc., and the ability of the child to recognize these and react appropriately to them when they are presented in print.

OTHER RESEARCH PROBLEMS

Arising from this lack of precision of definition, the research in cognitive processes and reading is difficult to synthesize. The research is also beset by other attendent problems; time and space permit the mention of only a few of these.

The Language factor in Comprehension - One of the major problems in assessing reading comprehension is to differentiate between the factors which are involved in language acquisition and those which are closely connected with the difficulties encountered in reading comprehension. As yet, research has revealed few of the differences between the spoken and written language. Linguists have frequently commented upon this but only recently have some of them begun to indicate, in sufficient detail, the nature of the difference between spoken and written language. Abercrombie's comments (1) are particularly pertinent to some of the aspects of written language which may inhibit comprehension. There still remains a yet larger problem - that of the nature of verbal understanding as a whole ..... As Russell (17) pointed out, this area has received scant

attention possibly because the complexity of the field is so great that few have attempted to understand what is still intrinsically a mystery of how thought is conveyed by words from one human being to another. Again, the recent work of several psychologists in the area of language and cognition may begin to yield much pertinent information for future researchers in reading.

The General Factors in Reading Comprehension - One of the earliest distinctions made as a result of research findings was that critical reading abilities were distinct from general reading abilities. Fairly early, too, it was established that though there was a minimal general factor in reading comprehension, major differences arose with respect to reading in various content fields. This has more recently been re-inforced by Davis' recent research (6). It is obvious that as far as cognitive processes are concerned, each substantive field of knowledge will present different modes of thinking when presented in written form. One other factor appears to be the cognitive nature of the writer's thought does not necessarily elicit an identical mode of thought response in the reader. However, this has rarely been investigated in depth, although several pieces of research, mostly still unpublished in the form of doctoral dissertations, indicate that this is probably so. A major factor in comprehension errors committed by readers may be their failure to be able to identify or empathise with the thought of the writer. A further problem occurs too, in that there may be cognitive limitations of the reader in terms either of his developmental maturity or of his unfamiliarity with the topic of the material.

Several investigations have focussed on the type of problems that appear to affect the quality of comprehension. It is proposed here to look at them in terms of problems which appear to be inherent in the material

and those which are indigenous to the reader.

The Problems Inherent in the Material - The genre or type of presentation which the author chooses to use, in addition to the constraints of the cognitive discipline under which he is operating, may present many problems to readers who are unaware of the nature and impact of these controlling factors. However, not only the substantive content but also the level and concentration of concept presentation may also form a barrier. In addition, the tone of the writer, his attitude towards both his subject and towards the reader, all apparently affect the level of comprehension. Again, several studies have suggested this, but few have examined the question in sufficient detail so that only generalizations which are so vague that they are almost impossible to translate into direct practice can be made.

Factors within the Reader - Though studies here are more numerous, even these are not very extensive. The results suggest that not only intelligence, but appropriate levels of cognitive development, including vocabulary and concept formation, are prerequisites to comprehension. Several years ago, Russell (18) suggested that "in all probability an inadequate vocabulary is the greatest single cause for failure to read with comprehension in either the general or technical field." Research since has substantiated this comment in detail, but further work has also shown an adequate knowledge of vocabulary depends upon the depth and breadth of meaning as well as the ability to understand the meaning of the word in use or in context. (17).

Several recent studies have shown how comprehension is subject to the biasses and attitudes of the reader and that such prejudices may be a product of the total environment, both within and without the schools which surround the child. It has also been shown that both the interest and the purposes of the reader will affect the level of his comprehension. Yet, while single studies have revealed this, there is not sufficient weight of evidence, as yet, to indicate the nature of the problem of determining bias, attitudes, interest, purposes, or prejudices, and how to influence this. There are still not sufficient cumulative research results upon which we can proceed with sufficiently security.

Some recent research with respect to the factors within the individual reader, has attempted to examine the impact of the psychological notion of cognitive style, and to attempt to assess how this will reflect the ability of the reader to read critically or independently. (12).

One of the most productive ways of analyzing problems encountered by readers either within the material or in themselves has been to analyze the errors that readers make. It has been in this area perhaps more than any other that ingenious attempts have been made, including the retrospective and introspective comments of the readers themselves on the processes that they appeared to be using as they read.

Problems of Measurement - A major deterent to research in cognition and reading has been the multitude of problems involved in devising appropriate measures. Most of the traditional standardized tests do not measure the type of cognitive thinking process that is involved in such activities as critical reading. As a result, most investigators have been compelled to

devise their own measuring instruments. Though these have usually been very carefully constructed and have been checked for reliability, the nature of the validity of these tests is not always clear cut. Since construct validity requires an accumulation of information and this is obviously lacking, the problems then become compounded. Most researchers develop their objectives or hypotheses and then construct tests which will measure these specifically. However, few researchers have attempted to use tests devised by other researchers arguing that they are not appropriate to their particular research. The time has come when it is essential that some more general measures which have greater pertinence to the cognitive processes in reading must be developed. A further problem arises in assessing the validity of the tests because of the problem of the nature of and type of transfer from general cognitive processes to those which may be involved in reading.

An even more difficult problem with respect to measurement may arise from the nature or type of response by which we measure achievement. For the most part, the response mode is that of asking questions. It has been well documented that these interrogative techniques may, in fact, structure the respondent's thinking and thus his reaction to what he reads. There have been some attempts to use such things as the 'cloze' procedure (13) or to ask general questions which are open ended and do not require a single correct answer. It would seem, however, that there is a great need of ingenuity in devising not only more appropriate tests but more appropriate response modes for measuring comprehension.

Furthermore, there are problems prevalent in the majority of research with respect to sampling, both of readers and the type of cognitive behavior appropriate to the differing reading materials. It would appear that

effective research should include as many variables as possible. A more extensive repertoire, which would cover the multiplicity of cognitive behaviors and the inclusion of a wider variety and content of reading matter, is essential.

The Inference of Reading Instruction on the Ability to Read Critically

Much of the "practical" research has concentrated on attempting to devise methods, materials and structures which attempt to improve the cognitive processes and, particularly, critical thinking involved in reading. Here, in recent years, the work of Lundsteen(11) Wolf, et alia (21) and Covington (5) should be noted. They have all carefully developed not only materials but methods, including specific lesson structures. Attempts have been made to control such factors as the Hawthorne effect, card stacking etc., since there has been abundant evidence that it is the teacher rather than either the materials or methods that has the greatest impact upon reading achievement. One of the most rewarding practical results would be the observations of the teacher-learning processes that have occurred in the experimental classrooms. The focus on this area might yield information which is most easily translated into suggestions for classroom practice but, hopefully, will also indicate the ways in which cognitive development takes place through the posing of cognitive intervention and arousal of cognitive dissonance. The latter has been suggested by psychologists as an important factor in progressive cognitive development. Again, carefully documented evidence about what is really happening in the classrooms is essential to more effective suggestions for lesson planning.

Research in Cognitive Processes or Reading Processes - Finally, there appears to be confusion in research as to whether cognitive processes or reading

processes and cognition are being investigated. It is frequently stated that process is under scrutiny whereas, in fact, what is occurring is that achievement in comprehension, is being checked under a variety of conditions. The lack of recognition that there may be differences between the process and the apparent product bedevills much of the research findings.

In general, then, much of the research, both findings and methodology, rarely leadsto more appropriate and specific techniques for teaching in the classroom. But we also need extensive and intensive work in investigating the processes as such, not only to increase our fundamental knowledge about reading, but as a surer way of devising more efficacious techniques.

Perhaps our greatest lack, at this time, is a comprehensive and satisfying theory or theories of reading which will attempt to collate all facets and will suggest the appropriate interrelationships. Current attempts at model making are to be applauded but each of these models usually starts from one orientation and rarely builds upon previous research. Nor does it integrate the many disparities of research finding. This may be asking too much at this stage in our development but at least we might begin to try. Sophistication in research is increasing and particularly the use that now can be made of computers to account for an ever increasing number of variables. If this is coupled with ingenuity in creating measures and penetrating reflective insights into relationships of many of the facets indicated here, and backed by careful research reporting, we might encompass a major breakthrough.

IMPLICATIONS FOR CLASSROOM PRACTICE

Though the findings of the research are sparse,some bear directly

on classroom practice. All the extant research shows that it is necessary to begin to develop aptitudes, attitudes and abilities, which hopefully, will mature into cognitive activities basic to the reading of more complex material. Such training must begin as early as Grade I.

A corollary of this conclusion appears to be that teaching and learning must be directed towards systematic, sequential development of these cognitive skills. It would appear that the skills development fall into two major areas. The first is concerned with eliciting the type of thought appropriate to the level of the development of the child and which is inherent in the material. This includes, of course, the establishing of an extensive vocabulary but also ensuring breadth and depth of understanding of the concepts enshrined in words. Moreover, there is mounting evidence that complexity of language often reflects corresponding complexity of thought and children must be made conscious of this. In particular, a recent study (15) has shown how important it is that children understand fully the meanings of the function words or connectives which frequently are the signposts to thinking. Unless the child understands the implications of such words as 'if', 'because', 'while', 'although', etc., he will inevitably misconstrue meaning. Awareness of the depth of meaning matures very slowly in children but again, a beginning must occur in the early grades.

The other area which research has shown lends itself to systematic development is the cultivation of judgment: the means by which statements are assessed. Wolf (21) has indicated that it is possible to start with elementary aspects of logic and introduce these in successive ways throughout the elementary school. But we then need to make certain that this is

practised and applied continuously at the secondary level.

The ability to recognize the relevant and irrelevant in statements, to be able to recognize or define by himself the problem or topic of the discourse, is also important. Too frequently, however, we have not allowed our pupils to come to their own decisions with respect to this, but have allowed them to reach a decision merely by choosing the alternatives, in reply to a multiple choice question. In addition, lessons need to be devised which will enable students to detect the tone and the feelings of the writer both towards the topic and towards the reader. The reader must also learn to evaluate the source and assess the values of this particular writer. But perhaps, more than anything, the reader must be taught "to know thyself": to know his own prejudices, his own biases and the probable causes of his misconceptions. He must make judgments of ideas, arguments, and conclusions in the light of his other experiences but must try to do this as objectively and dispassionately as possible. Yet, we should never ignore the fact that reading itself is an experience.

Another area to which we must ask teachers to apply their creativity is to explore a variety of means for eliciting comprehension. Traditionally, questions are the most used method. Questions may be posed by the textbook or by the teacher. Creative questioning by the teacher is one of the best known ways and is still one of the most effective ways of ensuring good comprehension. But in addition, we must train children to pose their own questions. The art of the self-posed question is the key to good reading. After all, in the normal reading situation no external questions are asked. From the earliest grades, children should be taught to question themselves and the material as they read.

Moreover, the questions asked by the teacher should have a greater depth and variety. Teachers need to ask questions designed to check whether or not the child is accurate in the information he gathers from the printed page. But, we should also make certain that these accuracy questions are interspersed with questions to which there are no right or wrong answers though there may be better answers, or alternatively, that answers may be better or worse, depending upon a legitimate differing interpretation. This difference may be the result of the extent of awareness of the silent clues to meaning.

However, this capacity implies an attitude of mind which is sometimes difficult for young children: the attitude of mind which will allow them to hold in apposition perhaps two conflicting, or opposing ideas before they come to a decision about them. The ability to withstand ambivalence is possibly a development trait. There is some evidence, however, that training will improve this ability. Rigidity in thinking may be one result of the over-insistence upon right and wrong answers. Sometimes, there are no right and wrong answers, but a child should know when there is an "either/or," or when there are hierarchical possibilities.

Teachers also need to recognize that other means of ensuring comprehension are possible. Outlining, summarizing, précis writing, or just the oral or written explanation of the content of the story is often revealing. In addition, teachers should become inventive in devising their own means of checking comprehension. Leaving a story unfinished and getting the children to suggest possible endings frequently means that the reader needs to have understood a good deal of the material.

Some material is now becoming available which treats directly some aspects of critical reading, and an attempt is made to establish both a hierarchy and sequence. (5, 11, 21)

In addition, we must ensure that thinking is developed in terms of a number of different thinking modes. This demands that we teach for transfer from one subject matter to another. We must teach the fact that explanation and the nature of the methodology of enquiry will differ according to each particular content field. We might show how descriptions vary in prose and verse, in science and literature, in social studies and in mathematics. This can often be done by use of direct comparison and contrasting of paragraphs and passages with the same theme presented differently. But we must also ensure that a variety of materials, newspapers, magazines, advertisements, letters, etc., are used. This variety of exposure to differing materials appears to result in greater flexibility and specificity of response on the part of the reader. Wide reading alone is not enough - it must be accompanied by understandings appropriate to the content.

Lastly, the teacher cannot assume that mere exposure to answering questions designed to assess comprehension will automatically ensure that this takes place. Each skill needs constant attention and needs to be applied at different levels according to the difficulty of the content. One of the most insightful ways that have been used to gain information about the process is the examination of the errors made in comprehension. This is an equally effective way of teaching ---The examination of comprehension errors and the suggestion that students should defend their answers are very productive ways of teaching, and learning.

CONCLUSION

The complexity and enormity of the problem of investigating the higher mental processes in reading may have been the factor that has prevented much research in this area. In the past decade, more psychologists have begun to tackle the problem and this has been reflected in an increasing awareness of the need to investigate this in reading. Since the topic is so wide, it is impossible, even with the small amount of research yet extant, to enumerate all the implications.

The problem seems to have been tackled in two ways and it is not always clear which factor is the one which is the most efficacious. One thing that has emerged is that children's thinking can be improved. It is not yet possible to assert, however, whether one can improve children's thinking through reading or whether children's reading improves through improved thinking. Perhaps this is a redundant question. Yet, we must encourage researchers to continue to explore this realm of research because the skill of comprehensive comprehension in today's technological world is becoming more important.

Emerson once wrote that "it is the good reader that makes a good book," but the quality of thinking in good books may be dependent on the quality of thinking which the good reader brings to that book. I can only paraphrase Tennyson in my own reaction to this field. It seems to me that this research "is an archway where through gleams that untravelled world whose margins fades ever and ever when I move."

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